mid - 9 $f(t) = 7 + e^{\cos t}$ $\frac{ft^3}{hr}$ $g = \begin{cases} 0 & 0 \le t < 6 \\ 125 & 6 \le t < 7 \\ 108 & 7 \le t \le 9 \end{cases}$

a) $\int_0^6 7t\, e^{\cos t}\, dt = 142.275$ ft^3

b) $7t e^{\cos t} - 108 \Big|_{t=8} = -59.583 \frac{ft^3}{hr}$

c) $h(t) = \begin{cases} 0 & 0 \le t < 6 \\ \int_6^t 125\, dt & 6 \le t < 7 \\ \int_7^t 108\, dt & 7 \le t \le 9 \end{cases}$

d $142.275 + \int_6^7 7te^{\cos t} - 125\, dt + \int_7^9 7te^{\cos t} - 108\, dt$

or

$\int_0^9 7te^{\cos t}\, dt - (0 + 125 + 108 \cdot 2) =$

26.3346 ft^3

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2.
a) $\frac{21-13}{7-5} = 4$ hundred entries / hr

b) $\frac{1}{8}\left[\left(\frac{0+4}{2}\right)2 + \left(\frac{4+13}{2}\right)3 + \left(\frac{13+21}{2}\right)2 + \left(\frac{21+23}{2}\right)1\right]$

$\frac{85.5}{8} = 10.6875$ hundreds of entries

average # entries in the box during interval from 0 - 8 hrs

c) $\int_8^{12} t^3 - 30t^2 + 298t - 976\, dt = 16$ processed

$23 - 16 = 7$ hundred not processed

d) max P: $P' = 3t^2 - 60t + 298 = 0$

$t = 9.1835$ $t = 10.8165$

t	8	9.1835	10.8165	12
P	0	5.0887	2.9	8

at t=12 midnight

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3 a) $\sqrt{\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2}$ $\quad \frac{dx}{dt} = 2t-4\Big|_{t=3} = 2$

$\sqrt{2^2+2^2} = \sqrt{8}$ $2\sqrt{2}$ $\quad \frac{dy}{dt}\Big|_{t=3} = 3e^0-1 = 2$

$= 2.8284$ m/s

b) $\int_0^4 \sqrt{(2t-4)^2+(te^{t-3}-1)^2}\,dt = 11.5877$ m

c) $\frac{dy}{dx} = 0 = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$ $\quad \frac{dy}{dt} = 0$

$\frac{dy}{dt} = te^{t-3}-1 = 0$ $\quad t = 2.2079$

$\frac{dx}{dt} = 2t-4\Big|_{t=2.2079} > 0$

d) i) $t^2-4t+8 = 5$ $\quad t = 1, 3$ $\quad$ moves right

ii) $\frac{dy}{dx} = \frac{te^{t-3}-1}{2t-4}\Big|_{t=1,3} = .4323, 1$

iii) $y(3) = \underbrace{3+\frac{1}{e}}_{\text{initial}} + \underbrace{\int_2^3 te^{t-3}-1\,dt}_{\text{displacement}}$

$= 4$

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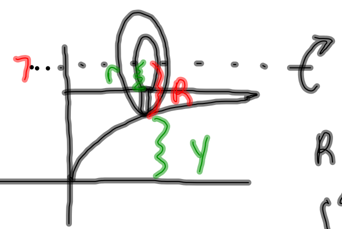
4. a) $\int_0^9 6-2\sqrt{x}\,dx = 6x-2x^{3/2}\cdot\frac{2}{3}\Big|_0^9$

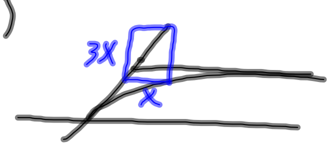
$= 6\cdot 9-\frac{4}{3}\cdot 9^{3/2} = 54-36$

$= 18$

b) 

$R = 7-2\sqrt{x}$ $\quad r = 1$

$\int_0^9 \pi(7-2\sqrt{x})^2-\pi\cdot 1^2\,dx$

c) 

$\int_0^6 3x^2\,dy$

$y = 2\sqrt{x}$

$\frac{y}{2} = \sqrt{x}$

$\frac{y^2}{4} = x$

$\int_0^6 3\left(\frac{y^2}{4}\right)^2 dy$

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5. $\frac{dy}{dx} = 1-y$ $f(1)=0$ $f(0)=?$ $\Delta x = -.5$

a)

x	y	y'
1	0	1
.5	-.5	1.5
0	-1.25	

$0 + 1\cdot(-.5)$

$-.5 + 1.5(-.5) = -.5 - .75$

b) $\lim\limits_{x\to 1} \frac{f(x)}{x^3-1}$ $\frac{0}{0}$ $= \lim\limits_{x\to 1} \frac{f'(x)}{3x^2} = \frac{1}{3}$

c) $\int \frac{dy}{1-y} = \int dx$

$-\ln|1-y| = x + c$

$\ln|1-y| = -x + c$

$1-y = e^{-x+c} = ce^{-x}$

Init cond $x=1$ $y=0$

$1-0 = ce^{-1}$

$1 = \frac{c}{e}$ $c=e$

$1-y = e\cdot e^{-x}$

$y = 1 - e\cdot e^{-x}$

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6. a) $\cos x = 1 - \frac{x^2}{2} + \frac{x^4}{4!} + \dots + \frac{x^{2n}}{(2n)!}(-1)^n$

$f(x) = \begin{cases} \frac{\cos x - 1}{x^2} & x \neq 0 \\ -\frac{1}{2} & x = 0 \end{cases}$

$f(x) \approx \begin{cases} \frac{-x^2}{x^2\,2} + \frac{x^4}{x^2\,4!} - \frac{x^6}{x^2\,6!} \cdots \frac{x^{2n}}{x^2(2n)!}(-1)^n & x \neq 0 \\ -\frac{1}{2} & x = 0 \end{cases}$

$f(x) \approx -\frac{1}{2} + \frac{x^2}{4!} - \frac{x^4}{6!} \cdots \frac{x^{2n-2}}{(2n)!}(-1)^n$

b) $f'(x) \approx \frac{2x}{4!} - \frac{4x^3}{6!} \dots = 0$ $x=0$

$f''(x) \approx \frac{2}{4!} - \frac{12x^2}{6!} \dots \Big|_{x=0} > 0$ ++ ∪

min at $x=0$

c) $g(x) = 1 + \int_0^x f(t)\,dt$

$= 1 - \frac{x}{2} + \frac{x^3}{3\cdot 4!} - \frac{x^5}{5\cdot 6!}$

d) $g(1) \approx 1 - \frac{1}{2} + \frac{1}{3\cdot 4!}$ $\epsilon < \left|\frac{1}{5\cdot 6!}\right| < \frac{1}{6!}$

by AST rem. theorem

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